

Internal Gravimetric Calibration Procedure for PUMPWATCH 'integrated measure' type test measure for determining the dispensing accuracy of retail fuel dispenser meters.

PUMPWATCH "integrated measure" Calibration Device

The calibration device on the PUMPWATCH 'integrated measure' type test measure comprises an adjustable position "fine calibration piston" otherwise 'piston' that is inserted inside the lower end of the measurement tube. The piston is fitted with an O-ring, that seals the annular space between the piston and the inside surface of the measurement tube.

The piston is connected to an externally threaded tube that passes through a threaded DELRIN collar that is fixed inside the lower end of the measurement tube by means of a set-screw the fine calibration set-screw, and screwed into and bonded to the measurement tube discharge valve to form the fine calibration/measurement tube discharge valve sub-assembly otherwise the 'fine calibration' sub-assembly.

Calibration Procedure – Preparation

The test measure shall be thoroughly washed and de-greased and suspended from a suitable calibration stand to dry for a minimum 24 hours before calibration.

Gravimetric Calibration Procedure

1. Place the 2-piece Calibration Stand on the weighing surface of the weighing instrument.
2. Set the weighing instrument scale at zero or 'tare'.
3. Suspend the test measure (without the discharge hose) from the calibration stand by inserting the stainless steel suspension arms or "trunnions" of the test measure into the corresponding slots in the vertical legs of the calibration stand H-frame.
4. Set the test measure so that the measurement tube is in the 'true' vertical position by adjusting the H-frame levelling screw so that it bears against the lower neck of the test measure, until the air bubble of the spirit level is in the middle position.
5. Check that the 3 x ¼-turn ball-valves on the test measure (the transfer tube valve, the main discharge valve and the measurement tube discharge valve) are in the closed position (with the valve handle perpendicular to the tube).
6. Observe and Record the mass of the dry test measure.
7. Set the weighing instrument scale at zero or 'tare'.
8. Introduce a quantity of water close to the required "nominal volume" of the test measure e.g. 20kg into the 20L test measure or 10kg into the 10L test measure.
9. Stir gently with glass rod.
10. Remove any droplets of water from the external surface of the main vessel, the scales and the calibration stand.
11. Observe and Record the temperature and mass of the test measure.
12. Use the temperature to establish the density of the water from the standard density tables
13. Use the density to calculate the actual mass of water required to provide the required nominal volume at that temperature.

$$\text{corrected mass of nominal volume (kg)} = \text{density} \times \text{volume} \times \text{buoyancy}$$
14. Carefully add (or remove) water via the main vessel until the required mass is reached
15. Check again that the measurement tube is in the 'true' vertical position. Apply gentle pressure to the opposite side of the funnel to the measurement tube to ensure the vessel is resting against the levelling screw and to avoid movement of the vessel during the transfer of water to the measurement tube. Gently open the transfer tube valve.
16. Gently close transfer tube valve once flow of water ceases, wait approx 10 seconds.
17. Observe the level to which the water rises in the measurement tube.
18. Record the results.
19. Discharge the test water by opening the main vessel and measurement tube discharge valves.

20. Once main flow of water has stopped, open and close main discharge valve 2 or 3 times
21. Using the stop clock, drain for the appropriate period (30 seconds for 2L – 20L vessels, 45 seconds for 50L and 60 seconds for 100L and 200L vessels)
22. Observe and record the mass of the 'drained test measure'
23. Observe and Record retention – this is the mass displayed on the weighing system after discharging and draining test vessel.
24. Set the weighing instrument scale at zero or 'tare'.
25. Introduce a quantity of water close to the desired "nominal volume" of the test measure e.g. 20kg, into a 20L test measure, 10kg into a 10L test measure
26. Stir gently with glass rod
27. Remove any droplets of water from the external surface of the main vessel, the scales and the calibration stand
28. Record the temperature and mass of the water.
29. Use the temperature to establish the density of the water from the standard density tables
30. Use the density to calculate the actual mass of water required to provide required volume precisely at that temperature

$$\text{Density} \times \text{volume} \times \text{buoyancy} = \text{actual mass of nominal volume (kg)}$$

31. Carefully add (or remove) water via the main vessel until the required mass is reached
32. Check again that the measurement tube is in the 'true' vertical position. Apply gentle pressure to the opposite side of the funnel to the measurement tube to ensure that vessel is resting against the tip of the levelling screw and to avoid movement of the vessel during the transfer of water to the lower neck of the main vessel to the measurement tube. Gently open the transfer tube valve.
33. Once flow of water stops wait approx 10 seconds, then gently close transfer tube valve.
34. Check the level to which the water rises in the measurement tube.
35. Read and Record results
36. If the meniscus of the column of water collected in the measurement tube level rises to the " 0 " mark on the scales then the measure may be considered to be precisely calibrated at required volume.
37. If the level to which the water rises in the measurement tube is above or below the " 0 " mark on the scales, the position of the water column in the measuring tube shall be adjusted using the fine calibration sub-assembly until the meniscus of the column coincides with the " 0 " mark on the scales.
38. To move column of water, loosen the set-screw at the base of the measurement tube until it is possible to rotate the fine calibration sub-assembly with respect to the delrin collar. Do not remove the set-screw entirely as the set-screw also serves to keep the delrin collar in place at the lower end of the measurement tube.
Rotate the fine calibration piston clock-wise or anti-clockwise as required, to raise or lower the piston and the column of water above the piston, until the meniscus of the column of water coincides precisely with the "0" or "strike" position on the measurement tube scale. Screw the set-screw back into place, making sure that it engages correctly with one of the vertical slots along the threaded barrel of the sub-assembly.
NOTE: when screwing the set-screw rotate the fine calibration piston carefully to ensure correct positioning of the slot on the threaded barrel with respect to the set-screw. Incorrect positioning may result in damage to the threads of the threaded barrel.
39. Record the Calibration Setting in respect of the fine calibration piston by noting the distance in mm from the upper edge of the piston to the - 1.0% line on the measurement tube scale.
40. Discharge water from main vessel and measurement tube.
41. Once main flow of water has stopped, open and close main discharge valve twice or three times.
42. Using stop clock, drain for 30 seconds.
43. Weigh test measure.
44. Record retention – this is the mass displayed on the scales after emptying the test measure

IMPORTANT

Never close valves while water is being discharged at full flow

Dry scale and exterior of vessel throughout the procedure

Open/Close main discharge valves during 30 second draining time

Do not add or extract water to or from the main vessel via the funnel once the transfer tube has been opened – remove the lid on the measurement tube to add or extract the required volume.

Repeatability Procedure

1. Do not re-set the weighing instrument scale at zero or 'tare'.
2. Introduce a quantity of water close to the required "nominal volume" of the test measure ie $\pm 40\text{g}$ under 'strike'
3. Stir gently with glass rod.
4. Dry any splashes of water from the exterior of the main vessel, the scales and calibration stand
5. Record the temperature and mass of the water.
6. Check again that the measurement tube is in the 'true' vertical position. Apply gentle pressure to the opposite side of the funnel with respect to the measurement tube, to ensure the vessel is resting against the tip of levelling screw and to avoid movement of the vessel during the transfer of water to the measurement tube. Gently open the transfer tube valve.
7. Once flow of water ceases wait approx. 10 seconds, then gently close transfer tube valve.
8. Check the level to which the water rises in the measurement tube.
9. Read and record results
10. Carefully add (or remove) water to or from the measurement tube until the water level the meniscus of the column reaches "0" in the measurement tube
11. Record the mass of the test measure
12. Use the temperature to establish the density of the water from the standard density tables
13. Use the density to calculate the actual volume of water

$$\frac{\text{Mass}}{\text{Density} \times \text{Buoyancy}} = \text{Actual volume (ml)}$$

14. Discharge water from main vessel and measurement tube
15. Once main flow of water has stopped, open and close main discharge valve 2 or 3 times
16. Using stop clock, drain for 30 seconds
17. Weigh test measure
18. Record retention – this is the mass displayed on the scales after emptying the test measure.

NOTE:

Repeat the "Repeatability Procedure" 3 times.

If results are inconsistent, re-do Calibration Procedure.

If desired, secure the position of the set-screw and of the fine calibration device with a wire and leaded seal.

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